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Abstract:

The objective of this article is to measure the extent of land conflicts and climate change on agricultural productivity and yields in the most conflict-prone regions of Chad. By analyzing data from 2000 to 2017 thanks to OLS, we obtained the results that the interaction of land conflicts in agricultural activity is a barrier to productivity and the improvement of agricultural yields. This is due to the expected deaths and the fear of cultivating a large area in a situation of insecurity. Collaborative management of land conflicts and regimes between local and customary authorities is not a stimulus to improve yields. Therefore, the effects of climate change on yields and productivity are dwindle by government reforms and subventions in the agriculture' sector. Hence, we recommend government to promote customary land tenure to reduce conflict and in other hand to trace transhumance corridors in order to support the State's agricultural reform efforts.

Keywords: Land conflicts, Land tenure, Agriculture productivity, Climate change.

JEL: Q15, Q16, Q54

I. Introduction

For mostly conflict related to land found their origin in the disproportional distribution or repartition of land area (Simmons, 2004). The problems relating to farmer conflicts remain a real concern in sub-Saharan Africa, and more particularly in Chad. The various conflicts opposing the Chadian peasant or farmer's populations do not date from today

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and show different natures. Some relate to lack of water, theft of animals and the destruction of growing areas (Sougnabé, 2007). Indeed, the case of Chad as for other countries of sub-Saharan Africa, troubles between the layer of agricultural peasant populations and herders, constitute a real obstacle to the motivations of agricultural production considering the consequences that they reveal.

According to the study report of Marty (2010), 15 Chadian prefectures and 26 Chadian townships surveyed have revealed that 78.5% of the conflicts are due to the straying of animals while 15% are attractive to water problems. Land area explain at least at 60% as a cause of the conflicts (SFCG & APRODAIT, 2014). Climate change leading to water scarcity is another cause. Indeed, for Marty's report, at least 91% of these conflicts are of serious intensity, as a result of the low involvement (7%) of justices of the peace of the country or the country in the management of said conflicts. Local authorities, including village chiefs, despite the limited resources and because of the tribal nature of their judgments, account for 90% of the resorption of pastoral conflicts. The lack of mastery of property rights issues leaves the traditional and administrative authorities lax to deal with the crises that plague farmers (Eck, 2014).
In another dimension from the facts listed above, the climatic changes observed today significantly influence the cultivable spaces creating a dilemma between the different producers and households (Ayalew et al., 2018 ; Kemkoye, et al., 2017). Nowadays, the increase of population and land management standards (property laws) either constitute land management variables and their exploitation (Gershon Feder & Feeny, 2012 ; Mooya and Cloete, 2007). Land distributions despite these established laws are made in a traditional way to each crop; in other words, they are customary, while climate is changing and creating a scarcity of land. Land arable is decreasing due to climate change, at the same time, land distribution in Chad is distribute through the peoples belong to a community or group. This trend makes repetitive land using caring by the way production decreasing. For the reasons which are announced land using in Chad depend on a "third dimension", means like mystic or occult strengths (Kemkoye, et al., 2017). Climate change and rational strategies of land using linked with green revolution has been demonstrated that, they impact productivity and urbanization (Ayalew, et al., 2018).

In general, the laws relating to the ownership of private property and land seems justify annexation of the cultivable surface or land property of any person by another (for our case a farmer by a breeder). Indeed, in Chad, Law No. 24 of July 1967, states that, the

possession of a private property requires before as any land system, a registration of the field exploited. A non-registration reveals the vacant (public) and non-owner status of the land (Article 13 of Law No. 24). Despite these laws, Land repartition are focus in traditional ways (In other hand in customary tenure) specifically at each crop season. Land management and conflicts in recent years is of more concern in urban than rural areas with increase in death rates due to land related conflict. In 2014, Chad government proposed an informatics system called Informatics Management and Secure Requests of Land Acquisition (IMSRA) in the objective to create a data base on property rights thus to promote the good land repartition in urban sector. The Article 340 of the same Penal code of 1967, states on different conflicts happened in the region of Hadjer Lamis (Massaguet and Gama) where farmers make a "guet-apens" to breeders. In fact, falling out laws on land and land tenure, farmers grow their crops around expressly creating conflicts that lead to murder.

Contrary to the strategies for resolving farmer-farmer conflicts in Niger, those in Chad remain less advantageous, since they are based on futile interventions by the authorities responsible to establish order. In reference to the rural code of Niger for security and land conflicts prevention, conflict management is transferred from customary authorities to judicial, under some conditions or facts. Indeed, can be considered as annexation of a property when the field damage source of the conflict is committed in a space of hydro-agricultural development or protected field during a season of culture.

The salient or important facts as well as the conflicts identified in Chad for the framework of this article, are delimited around three regions. In fact, these are areas with considerable capacity and arable land accompanied by a population with a low literacy rate. These are mainly the region of Mayo-Kebbi, Moyen Chari and Mandoul. The vast majority of the population of these regions is primarily engaged in agriculture. While the cultivable in Chad area covers only 499,350 km^2, for an estimated population of 14 million (World Bank, 2016), the agricultural sector represents only 23% of GDP. This does not ensure food self-sufficiency, despite the other side of the estimated number of livestock meanwhile has at least 94 million head. Despite the fact that the causes of land conflicts in Chad are returning to the conception of land acquisition based on ancestral reasons as in Cameroon (Socpa 2010), the management of these conflicts on the other hand remains nuanced. Conflict resolution remains an arbitration depending on whether one is in the region of Moyen Chari, Mayo Kebbi or Salamat. In the first two regions conflict resolution is ensured respectively by peacekeepers (Gendarmes) on the one hand and traditional authorities on the other. Whereas in Salamat conflict prevention is a matter

for the development of national institutions such as CELIAF, CLDR[‡] and others (Kemkoye, et al., 2017).

For the majority of studies on the causes of these conflicts (Marty, et al., 2010), the search for grazing, the migration (of pastoralists) because of the attacks of certain rebel groups or lack of water, drought are the main ones. The most relative proposals aimed to eliminating or even restricting the negatives impact of these conflicts, do not resolve today the conflicting trend between the layers concerned. Despite the pastoral hydraulics project (DHP-AFD) and the prevention of conflicts adopted by the government since 1993, for resolving farmer-farmer conflicts, results are inconclusive. Climate change, capitalist behavior, population growth has improved this situation. Most articles on land issues in Chad are treated from a sociological perspective without empirical or econometric analysis.

The objective of this study is to contribute the review of empirical literature on the question of land tenure in Chad and conflicts between farmers themselves and breeders. As a first step, it seeks to explain the margin of loss in food self-sufficiency and productivity policy of Chadian farmers and herders in land conflict and climate change situations. Indeed, it tries to restore the resilience between farmers and herders and to emit new strategies of protection of the lands exposed to the conflicts. In fact, apart from the low level of research and studies in Chad on this field, conflicts around land continue remain topical and makes victims thus binding migrations from the labor (workforce) to less advantageous activities for Food self-sufficiency and well-being. Then this paper aims to set the stage for empirical studies of the implications of agricultural conflicts on agricultural productivity and the contribution of property rights in Chad.

II. Literature review

Land onflicts can to some extent concern farmers (farmer-farmer conflict) or breeders only and in another dimension both. Diversity in the design of property rights (private, communal or customary) can amplify conflicts (Conning & Deb, 2007) if there is no real understanding between authorities (urban and/or rural). The diversity of activities and householders remain the principal explaination of conflict. For Koler[§], land must be shared between a community whose activities are similar, that he qualify of "ethonogeographic communities", one of best way to prevent conflicts. Howard (1998),

[‡] CELIAF : Cellule de Liaison pour l'Autonomisation de la Femme
CLDR : Comité Locale de Dialogue et de Réconciliation
[§] Cite by (Fine , 2010)

By examines land conflicts around natural resources in Nicaragua, also notes the negative impact of institutions quality on land tenure. Indeed, in absence of coordination between authorities responsible for sharing and management of the land and lack of funding, the land that used becomes less ptimal. In addition, analysing the difference between land tenure in Northen Sudan and Ghana, Yasin & Obeng-Odoom (2012), aligns with the fact that customary lands rights, cause of marginalization, land conflicts and decreasing of productivity in these countries, and mostly in Sundan. Indeed, for many countries like Chad, with traditional laws basicaly based on customary land tenure, property rights on land must be correlated with government objectives.

According to Socpa (2010), land conflicts in Africa and in particular in Cameroon, are consequence of conceptuals facts on the one hand and the other from distributive policies (Bone, 2012). Most of population refers themselves to ancestral lagacy land or the national character of land ("Free Land and Land without Masters"). While Simmons (2004) treating of the forces interacting in land conflicts at the local level in Brazilia, concludes a relationships between population concentration and conflicts. Therefore, author infers a direct andd indirect link of concentration on rancher employment and farmers conflict due to a bad land repartition. The more land inequality or repartition related to the growth of population and scarcey of land rantable, is higher, land conflicts become superfluous (De Luca & Sekeris, 2012). Questions on property rights and the implications of capitalist behaviors in a scarcity economy has been treat in many contexts. In fact, on each domain the capacity to make a use of the land or goods give a sense to the property rights notion (Alchian & Demsetz, 1973).

The first approach which has taken the in consideration property rights and the quality of institutions in economic analysis were born from the questioning of neo-classical theory by the New Institutional Economy (NIE). Neo-classical economic hypothesis are focus on economies with a higher endowment of factors of productions and the absence of asymmetric information's, the NIE School brought a conclusion based on how resources are sharing (Manya & Cloete, 2007). Institutions and their structure (Gershon Feder & Feeny, 2012 ; Menard, 2001), through property rights are the best way to minimize economic constraints in scarcity situation to promoted economic development (Goldstein & Udry, 2008), despite the influence of transactions cost (Payne, 2002).

The identification of different types of property rights by Eggertsson, (1990) gives many conceptions (Manya & Cloete, 2007). Considering his position, the legal land exploitation in the objective, to obtain productivity, incomes and to deals it (land using transfer)

corresponding to the rights detention. Property rights can also refer to the ownership selling rights or to a land tenure when land belong to a community, a collectivity (Boudreaux & Sacks, 2009). In general, property rights notion is focus on the significant part of investment induced in the secure land (Carter & Olinto, 2003 ; Deininger, 2011).

For the world Bank (2005), secure land by property rights improved land investment, consumption (Gray & Gray, 1998), in the sense of financial development promotion in others terms. However, the property rights based on a traditional conditions or manage by traditional authorities does not lead to an increase financial credit (Yasin & Obeng-Odoom, 2012). In this case, it is important to make a difference between financial institutions which can accept promoted the increasing householder's or farmer's incomes, among those with classical financial conditions. By measuring factors which influence farm and productivity in rich and poor countries, Adamopoulos & Restuccia (2014), found that apart the known factors of productions (Labor, Land, capital), policies adopted or all two type above institutional can affect productivity through land distribution. Therefore, from the moment where in each considered countries land secures policies lead investment increasing.

Land secure promote farmer productivity and increase their income when farmer belong to a social, institutional or political group (Goldstein & Udry, 2008). Stating on three formal characters of institutions, which focus firstly on the society rules, on law and how it is organized; then on some constitutional decisions and finally on "culture values", Gershon Feder & Feeny (2012), noted a possible transfer of land property endowment based on clanic behavior or cultural decision. Institutional quality become a fact. According to Fenske (2013), the weak quality of instiutions in african countries mostly comes from their classical land tenure, market structure. In other terms institutions are based on "precolonial strategies" without any restructurations discouraging in major part productivity.

III. Methodology

1. Model

Cobb-Douglas function using to achieve simplified production functions (high elasticity of substitution) such as translog function and CES permitted to make it easier to understand interactions between variables in a specification (Pavelescu, 2011). Following the example of Kislev & Peterson (1982), who used biotechnology variable as a substitute variable of technology of technology in the production function (Sato, 1967) a part from

usual factors variable as labor and Capital. We consider as well as Adamopoulos & Restuccia (2014), a CES function of production in an agricultural production economy (unlike the production of non-agriculture goods) or not, defined as follow:

$$y_a = A_{\text{ɔ}}[\theta k^{\rho} + (1-\theta)(sl)^{\rho}]^{\frac{\aleph}{\rho}} \quad (1)$$

$$y_n = AK_n{}^{\alpha}N_n{}^{\beta} \ (2)$$

With y_a and y_n the output of farmer *s, l* and *k* irrespectively the inputs amount of labor and capital. N and K are aggregated level of above inputs. The translog function of production will measure conflicts implication on farmer's productivity in considers region. Then:

$$lny_n = logA + \alpha logK_n + \beta logN_n \ (3)$$

By considering the relaxing of constraints on some parameters and by taking consideration of homogeneity of production, the estimate model can be introduced by the equation given by:

$$lny_{it} = \pi_0 + logA + \alpha logK_{it} + \beta logN_{it} + \alpha_1 log^2K_{it} + \beta_1 log^2N_{it} + \delta_{KN} logK_{it} * logN_{it} + \mu_{it} logK_{it} * X_t + \vartheta_{it} logN_n * X_t + \theta_i X_t + \varepsilon_{it} \ (4)$$

X_t is the matrix of the *conflict* interest variable. Indeed, the use of the variables dummies will allow to estimate the effects of the conflicts on the farmer's production, this through labor factors, implicitly on the capital (K) and others factors. Thus we will estimate productivity and the production yield in situation where $X_t = 1$ (conflict case) and $X_t = 0$ otherwise. The estimated model establish as following:

$$y^*{}_{it} = \rho_0 + \rho_1 Conflict_{it} + \rho_2 logDec_{it} + \rho_3 logDep_{it} + \rho_4 ConflictRes_{it} + \rho_5 logAreaC_{it} * LandT_{it} + \rho_6 logDimR_{it} + \rho_7 LandT_{it} + \rho_8 logAreaC_{it} * Clim_t + \rho_9 ModAgri_{it} * Conflict_{it} + \rho_{11} logPopSurf_{it} * Conflict_{it} + \varepsilon_{it} \ (5)$$

$y^*{}_{it}$ is the variable of production given by the logarithm of the production and agriculture yield in the region *i* at the consider period. This variable includes the production of millet, sorghum, rice and maize. Due to the traditional understanding of land tenure in Chad, we will take in our observation some transitions which exist on the character of land tenure when conflict resolution is share between others jurisdiction and customary tenure (or mixed tenure). Alongside the ***(Conflict)*** variable, we will integrate like Simmons (2004) ; Eck, (2014) and Rudianto & Andi (2014), Death related to conflict ***(Dec)***, population density ***(DeP)*,** cultivable area ***(AreaC)*** (Carter & Olinto, 2003) and Region dimension ***(DimR)***. About the control variables, we will include variables

as land tenure ***(LandT),*** conflict resolved by authorities (mixed or customary) ***(ConflictRes),*** agriculture employment ***(ModAgri)*** and the proxy variable of climate change ***(Clim)*** apprehend by the level of temperature***. PopSurf*** capture the cultivable share of the population in each region.

In the context of different or variable technology used to improved agriculture productivity, none parametric method according to Ozcan et al. (2001) is although useful. The model will be estimated by OLS (Ordinary Least Square) in our case and due to the fact that our endogenous variables are not binaries.

2. Data sources

Samples of our paper work will come from the regions of Mayo Kebbi, Logone orientale, Salamat and Moyen Chari. The choice of regions is justified by the frequency of conflicts observed and the importance of their contribution to the production and marketing of agricultural products in Chad. Given these areas and the dynamic nature of conflict impacts, the panel data that will be used will be spread over a 5-year period. Thus, we will take as a period of study, from 2000 to 2017. Our data are collected from the data base of the Ministry of Agriculture in Chad, Stat World data on climate change and the World Bank. Conflicts variables are obtained thanks to documentary reports of Newspapers (Lavoix, Tchadactuels etc.).

IV. Results and discussions

The result in Table 1 shows the most normal and plausible effects expected with respect to climate change and land tenure. Moreover, the resolution of land conflicts does not show any significant results. Thus, it follows that when cultivable areas increase (AreaC) by 1 ha in cultivable areas negatively affects agricultural yields in the regions concerned by at least 0,76% and at the 1% threshold. Indeed, this situation can be explained by climatic degradation and land impoverishment. For Mooya and Cloete, (2007), the demographic population can lead to a driving effect to reduce and/or distribute yields in the regions. This result remains plausible on the one hand by the significant negative effects on production and yields at the 1% threshold of the region's size (DimR). On the other hand, the PopSurf variable also shows at the 1% threshold that a strong demographic growth of 1% in the regions leads to a scarcity of cultivable land exploitation reducing agricultural yields and productivity.

Table 1: effects of climate change and land tenure on the productivity and yields

Variables	Production	Yield
Ldec	*-0,0681389*	*0 ,0320226*
	(0,151)	*(0,248)*
Lconflictres	*-0,0547434*	*0,0595448*
	(0,579)	*(0,322)*
Lareac	*-0,1174005*	*-0,7677554****
	(0,555)	*(0,000)*
Ldimr	*-0,6763918****	*-0,2052931**
	(0,006)	*(0,099)*
landT (M)	*-1,09883****	*-0,746303****
	(0,000)	*(0,000)*
ModAgri	*0,0223811*	*0,0600282**
	(0,655)	*(0,068)*
lpopSurf	*-1,255247****	*-0,7355328****
	(0,000)	*(0,000)*
Cte	*20.896****	*16.105****
	(0,006)	*(0,001)*
R^2	*0,997*	*0,964*

Source : authors

In a certain dimension, land tenure has a negative and significant impact on yields and production. Significant relationship to the 1% threshold. Indeed, outside the Mayo Kebbi region, which exercises customary land tenure in conflict resoption, the other regions resolve conflicts in a mixed manner with the military authorities (police forces). The results show that mixed conflict management affects negatively agricultural productivity and yields in the regions that use it by more than 10% and 7.4% respectively. Indeed, conflicts in most cases are managed by law enforcement agencies engaging in arbitrary judgments. In a way, this shows the incoherence and mismanagement of conflicts and land tenure systems. A system of land acquisition through customary conditions seems to be a good outcome. For Marty et al (2010), the Mayo Kebbi region is able to reduce and resolve conflicts through traditional land tenure or management regimes.

The idea of this article is to highlight the impact of land conflicts and climate change in a context of non-conventional land tenure and/or management on agricultural productivity and yields in Chad. The following table 2 shows the results of the interactions between the different subsequent interest variables. Thus, we can easily see that the significant and positive effect of climate change on yield at the 10% threshold (at least 0.27 points for 1 point of °C) can be explained by the agricultural reforms undertaken since 2002 (the era of oil exploitation). However, when compared to arable land (AreaC), climate change (average temperature variation of 30°C from 2000) negatively and significantly affects agricultural yields at the 1% threshold (INSEED, 2009; Ayalew, et al., 2018).

Table 2: interaction with land tenure and conflicts variables

Variables	**Production**	**Yield**
Ldec	*-0,03719*	*0,04719*
	(0,562)	*(0,262)*
Lconflictres	*-0,004894*	*0,0886814*
	(0,972)	*(0,331)*
Climat	*-0,14821*	*0,276068 **
	(0,465)	*(0,061)*
*lareac*LandT(M)*	*036294*	*0,1504543*
	(0,342)	*(0,523)*
*lareac*climat*	*0,001149*	*-0,0268329****
	(0,915)	*(0,006)*
Ldimr	*-0,642120***	*-0,1843097*
	(0,028)	*(0,237)*
LandT(M)	*-5,28698**	*-2,506892**
	(0,050)	*(0,075)*
*ModAgri*conflict*	*0,01364*	*0,0556769*
	(0,805)	*(0,147)*
*lpopsurf*conflict*	*-0,96135***	*-0,6288933***
	(0,022)	*(0,019)*
Cte	*23.132****	*8.17444**
	(0,0060)	*(0,060)*
R^2	*0,9919*	*0,9653*

Source: authors

Several researchers have reported theoretically on the effects of land conflicts on productivity in Chad. Our empirical results show that an interaction of conflicts with the shares of cultivable land by population has a negative impact on agricultural yields (for a conflict aspect) at 0.96% and 0.62%. The upsurge in conflicts and their mixed management between traditional and military authorities perpetuates in some respects the harmful effects. For the Niger Rural Code, beyond mixed management, it is imperative to set up competent judicial bodies. The effects of land tenure systems remain negative and significant at the 1% threshold despite integrated interactions.

V. Conclusion:

The objective of this article is to make an empirical contribution to the effects of conflicts between farmers and herders in four (4) regions of Chad in a context of climate change. First, it appears that the effects of climate change can be mitigated through agricultural reform policies. However, it is important to control the upsurge in conflicts, the effects of which remain significant on agricultural yields. Secondly, harmonization of land tenure and conflict management systems alone cannot mitigate conflicts in order to improve agricultural productivity and yields. While the initiated transhumance corridors have not reduced land conflicts, the framework of the Mayo Kebbi region in its management through traditional or customary conflict regimes may be the subject of particular attention.

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